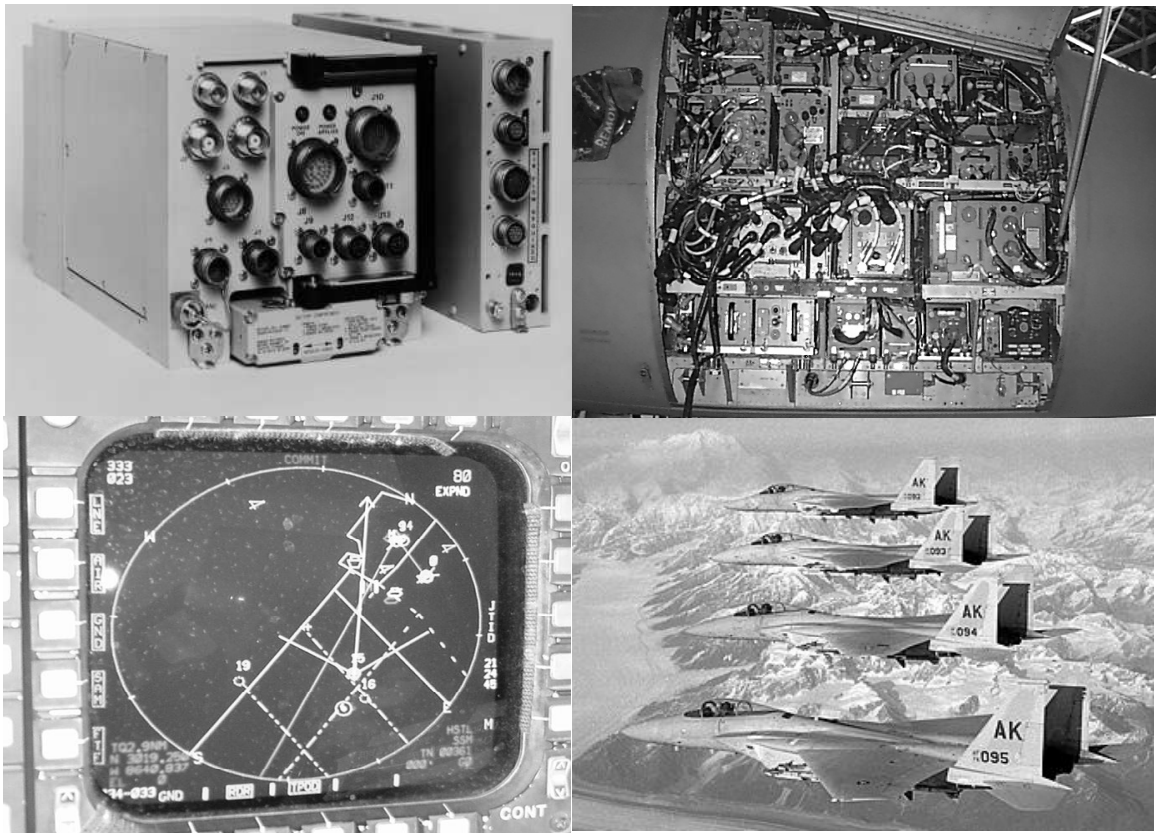
FIGHTER DATA LINK (FDL)



Joint ACAT ID Program (Navy Lead)

Total Number of Systems:	685
Total Program Cost (TY$):	$180M
Average Unit Cost (TY$):	$171K
Low-Rate Initial production:	4QFY98
Full-rate production:	1QFY00
F-15A/B/C/D FDL QOT&E:	4QFY99
F-15E FDL QOT&E & MS-OT:	2QFY00
B-LRIP Report Submitted:	1QFY00

Prime Contractor

Boeing – Platform Integration
Data Link Solutions – FDL Terminal

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Multifunctional Information Distribution System Low Volume Terminal 3 (MIDS-LVT 3) Fighter Data Link (FDL), integrated into the active Air Force and Air National Guard (ANG) F-15 fighter aircraft provides **Total Force** situational awareness and sensor cueing in support of the air superiority and air interdiction mission areas. The FDL provides Link 16 data link networking with other Link 16 capable fighter aircraft, command, and control systems to support *synchronized operations*. Link 16 is a Joint and Multinational data link with a common message standard and robust jam-resistant communications waveform providing Joint and Multinational **interoperability** to enable these forces to operate effectively together. As integrated into the F-15 fighter aircraft, FDL provides the fighter aircrew

and off-board command and control with a *common relevant operational picture* to apply ***information superiority*** to support ***precision engagement*** and ***dominant maneuver***. F-15 flight leaders use the information and capabilities provided by FDL to avoid threats, locate and identify targets, coordinate engagement by flight members, and disseminate Battle Damage Assessment reports—all in real-time.

The components of FDL include the terminal, remote power supply, F-15 Situation, and Heads Up Displays and controls. The FDL terminal shares a number of Shop Replaceable Unit components with the Multifunctional Information Distribution System-Low Volume Terminal (MIDS-LVT) family of terminals, providing an improved level of ***sustainment interoperability***.

BACKGROUND INFORMATION

The FDL was developed to satisfy an Air Force "Urgent Need" for a Link 16 data link capability for the F-15 fighter aircraft. The terminal was developed independently by the Air Force, but under the umbrella of the MIDS LVT program, and shares approximately 25-30 percent hardware and software commonality with MIDS-LVT. By design, the FDL has less capability than MIDS-LVT: this is a trade-off for lower cost, earlier delivery, and improved terminal reliability while still meeting minimum Air Force and Air National Guard requirements for a Link 16 interoperable data link. The FDL terminal design is modular and shares a common chassis with the MIDS-LVT so that additional capabilities, Tactical Air Navigation, digital voice, and high terminal transmitter output can be inserted into the FDL terminal if required.

The initial host platform for the FDL was the F-15C/D air superiority fighter aircraft. During late FY97, the F-15E air interdiction fighter aircraft was added and the FDL design was modified to create a "common configuration" terminal that could be installed in either fighter aircraft. In FY98, the Air National Guard selected FDL to satisfy their F-15A/B data link requirements.

TEST & EVALUATION ACTIVITY

During FY00, the FDL completed the Combined Electronic Warfare (EW) Developmental Test/Operational (DT/OT) Test, F-15E FDL Developmental Test (DT), Combat Air Forces (CAF) and Joint Interoperability Test Center (JITC) Link 16 interoperability certification tests, F-15E FDL Qualification Operational Test and Evaluation (QOT&E), F-15E FDL Multi-Service Operational Test (MS-OT), FDL Information Assurance (IA) Vulnerability Assessment, and a Maintenance Demonstration. Over 217 FDL flight hours were recorded during FY00 using Common Configuration EMD and LRIP Fighter Data Link terminals.

The F-15 Program Office provided two FDL IA Vulnerability Assessment Reports during May 2000, and AFOTEC released their QOT&E report during May 2000. The developer and AFOTEC provided DOT&E with a DT and OT results briefing on May 23, 2000. The 46th Test Squadron provided a DT Results Report during May 2000.

The F-15E DT (September 1999-March 2000) was conducted primarily at Eglin AFB and the Boeing Corporation St. Louis F-15E bench. The DT evaluated the maturity of FDL integration into the F-15E, as well as corrections to the deficiencies in the FDL F-15A/B/C/D integration discovered during FY99 testing. The DT effort was an open process that included full visibility and frank information exchange with the OTA, developers, and the two contractors.

The combined F-15E DT/OT was conducted from October 6-7, 1999, using the Eglin AFB, FL ranges and adjacent over-water airspace. This test evaluated FDL performance against Big Crow airborne and ground-based jammers, emulating the threat defined in the approved System Threat Assessment Report. Combined DT/OT consisted of two primary profiles: a controlled radial and beam flight pattern by both the F-15E aircraft and Big Crow airborne jammers to measure sensitivity levels at various ranges and aspects, and a realistic scenario involving the approach, location, and simulated air attack of a defended ground target screened by Big Crow jammers.

The CAF F-15E FDL Link 16 certification is an Air Force prerequisite for entry into a Joint Interoperability Test Command (JITC) Link 16 certification. The F-15C/D FDL completed Link 16 certification tests during FY99. The F-15E Link 16 implementation completed CAF certification testing in November-December 1999 and JITC certification testing in March 2000. These certifications are laboratory tests that evaluate message implementation into the host platform, per Military Standard 6016, and the interoperability of the messages with other certification test participants.

AFOTEC conducted F-15E QOT&E from January-March 2000, using the Eglin AFB and Nellis AFB ranges. At Eglin, FDL equipped F-15E fighters flew operationally realistic air interdiction and time critical targeting missions cued by the E-8 Joint Surveillance Targeting Attack System (JSTARS) using Link 16 messages. The Nellis portion employed large numbers of Link 16 capable F-15C and F-15E aircraft in a composite interdiction package controlled by Navy E-2C Hawkeye Airborne Early Warning (AEW) Hawkeye 2000 aircraft.

The MS-OT was conducted in two phases: the first during October 1999 with Link 16 equipped Army Air Defense platforms and the second in conjunction with work-ups for exercise Pacific Blitz. During Pacific Blitz, the FDL F-15Es operated with Navy Link 16 capable platforms. The October 1999 Link 16 network included F-15E fighters, the E-3 Airborne Warning and Control System (AWACS), the Control and Reporting Center (CRC), the Patriot, and the Forward Area Air Defense Command and Control (FAAD C2) platforms. The March 2000 Pacific Blitz work-ups Link 16 network included F-15E fighters, E-2C AEW Hawkeye 2000, and an AEGIS cruiser, USS COWPENS.

In response to a recommendation in the DOT&E Fighter Data Link B-LRIP Report, and consistent with the November 1999 DOT&E policy on IA, the F-15 System Program Office (SPO) funded a FDL IA Vulnerability Assessment. The independently conducted assessment by the Electronic Systems Command Information Warfare Office at Hanscom AFB evaluated FDL manufacturing, test, and operational processes, including Air Force network design and transmission.

The FDL B-LRIP also recommended conduct of a maintenance demonstration to assess FDL Built-In Test (BIT) maturity and adequacy of maintenance publications. The F-15 SPO completed this demonstration with AFOTEC oversight during April 2000. The BIT demonstration was conducted using the F-15E bench at Boeing, (St. Louis) while review of the maintenance publications were conducted at the F-15 Organizational Maintenance Flight at Nellis AFB.

The FOT&E of Fighter Data Link reliability and logistics supportability commenced in April 2000. AFOTEC is conducting FOT&E through data collected from test and operational F-15 FDL equipped units. The first operational F-15C/D squadron at Elemendorf AFB, AK, and the first operational F-15E squadron at RAF Lakenheath, United Kingdom have begun modification to install LRIP FDL terminals. These installations will be complete by the end of the calendar (2000) year, allowing the Air Force to declare Initial Operational Capability for FDL.

TEST & EVALUATION ASSESSMENT

F-15E FDL integration completed OT and was assessed as operationally effective and operationally suitable. FDL met or exceeded all effectiveness COIs, including message success rates during dedicated communications jamming. Compared to JSTARS targeting using voice communications, JSTARS Link 16 targeting provided F-15E aircrew with significantly improved target detection accuracy and strike timeliness. During MS-OT, FDL implementation into the F-15E consistently demonstrated the ability to effectively communicate with Army and Navy Link 16 capable host platforms. Participant location and identification, targets, commands, and engagement coordination messages were exchanged during the execution of realistic combat scenarios in four different types of test range environments.

The MS-OT and QOT&E testing did identify some message implementation deficiencies and information latency issues from the off-board platforms—particularly the E-8 JSTARS, E-3 AWACS, and E-2C AEW. One F-15 display problem with surface ship identity was also discovered. Additionally, AFOTEC indicated that tactics designed to leverage the capabilities of Link 16 information to achieve engagement advantage in the fighter have yet to be developed, although one of the QOT&E missions provided a promising example of an air-to-air tactic reliant on Link 16 information exchange.

The data from DT, combined DT/OT, QOT&E, and MS-OT included 337 FDL flight hours on all models of the F-15 fighter. While the data indicated that the FDL demonstrated a Mean Time Between Critical Failure (MTBCF) of 84 hours, it did not demonstrate the requirement of 1,000 hours MTBCF. The demonstrated MTBCF did exceed the F-15 Class 2 Joint Tactical Information Distribution System MTBCF of 17 hours and the FDL demonstrated a mission-ready Operational Availability of 98 percent. QOT&E was also unable to resolve the evaluation of logistics supportability. AFOTEC is conducting FOT&E to resolve reliability and logistics supportability issues.

The F-15E FDL Link 16 implementation was certified by the CAF as interoperable with other Air Force Link 16 host platforms. The evaluators stated, “No significant software problems were identified.” The JITC post-certification test Joint Analysis Review Panel, consisting of voting members from all Services and the National Security Agency, voted unanimously to grant interoperability certification to the F-15E FDL implementation. The test results indicated some minor problems in message implementation, which were documented and sent to the Air Force for resolution.

The Information Assurance vulnerability assessment indicated that the processes and procedures in place at the Data Link Solutions factory, Government Test Facility, depot, and the Air Force Link 16 network design facility, including the alternate design facility, were at low risk to the integrity and availability of FDL Link 16. The report also stated that safeguards were in place to mitigate these risks. DOT&E still has some concern with one of the methods employed to transmit Link 16 network design and updates to airbases, and has requested the Air Force to investigate and report potential mitigations.

The BIT demonstration conducted on April 19, 2000 indicated that the F-15E host would not recognize 37 percent of the faults sent to it by the FDL terminal. Data Link Solutions, the FDL terminal developer, was present at the demonstration and able to understand and diagnose the cause. A fix to the terminal BIT was provided in a subsequent FDL software release and successfully re-tested in July 2000.

CONCLUSIONS AND RECOMMENDATIONS

FDL completed operational testing in 2000, and was evaluated as operationally effective and suitable. FDL provides the F-15 fighter with a robust and joint interoperable communications link capable of contributing to a common relevant operational picture. However, the full implications of this capability on precision engagement and dominant maneuver have not yet been realized due to the immaturity of concepts of operation, tactics, and stove-piped implementation of Link 16 into various host platforms by developers that may not appreciate the information needs of off-board host platforms. Future enhancements of FDL Link 16 implementation into the F-15 fighter aircraft include imagery, sensor cueing, and high throughput. The effect of these enhancements on Joint Vision 2020 operational concepts, Joint and Multinational Interoperability, off-board platforms, and overall Link 16 design architecture must be evaluated.

FDL development was spiral in nature, incorporating more host platforms, additional requirements, capabilities, and graduated testing throughout the relatively short EMD phase. Despite these challenges, a product the user clearly desired was developed and fielded. The key was the process. FDL development and the test program featured open visibility and communications between Program Management, the users (Air Combat Command and ANG Requirements), the two contractors, developmental testers, AFOTEC, and OSD. The FDL program is now actively sharing its successes, failures, processes, and lessons learned with other Link 16 integration programs including the F-16, F/A-18, B-1, and B-2 bombers.

Participation of Total Force elements, the ANG in this program, greatly contributed to FDL design and test effort. ANG provided additional flight missions to support DT and the evaluation of operational effectiveness and suitability issues. The ANG avionics maintenance technicians supported the maintenance remove and replace tests. Also, the ANG was able to source a number of ANG F-16 aircraft to support the test as simulated adversaries with advanced capabilities.